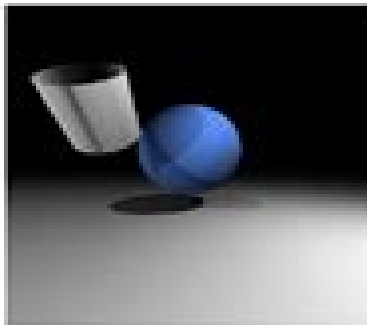
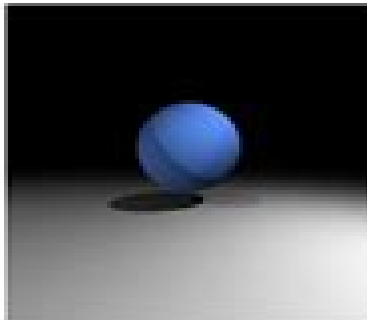


Exploring Computer Graphics: Photorealistic and Non-photorealistic rendering

Brittany Chin '16

Computer Science, Colby College, Waterville, ME

Photorealism: Ray tracing



Photorealistic rendering is the process of developing synthetic images that look real, based on geometry, perspective, and lighting.

I chose to implement a ray-tracer, which renders the image by shooting rays of light into the scene, and tracing along those rays to see if and where objects intersect the rays.

When the rays of light do not reach the ground because they are blocked by an object, shadows are drawn dependent on where the light source is coming from.

Non-photorealism: Filters

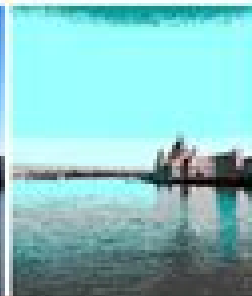
A non-photorealistic rendering system deals with the techniques of making images that mimic artistic styles. Examples of this could be simulating watercolor on paper, the strokes of a brush with paint on it, or applying filters to images to give them different artistic styles.

Here I have implemented a filter which gives the effect of a printed or layering technique. Each RGB value from the original image was mapped to a color in a set palette based on which color it was most closely related to (using a Euclidean distance with each R, G, and B values on a scale from 0 to 255).

Before



After



Curves and Modeling

Curves are an integral component of more complex computer graphics techniques. Different types of curves, such as Bézier curves, can be used to create surfaces which then lead to 3D models.



Surfaces



Blair Mennel / 2014

Computer Graphics Applications

- Video games
- Animation
- CAD Modeling
- Movie special effects
- Virtual reality

Nonphotorealistic Computer Graphics

Rachel Sandford



Nonphotorealistic Computer Graphics:

Non-Photorealistic Computer Graphics Thomas Strothotte, Stefan Schlechtweg, 2002-04-24 Even as developments in photorealistic computer graphics continue to affect our work and leisure activities practitioners and researchers are devoting more and more attention to non photorealistic NPR techniques for generating images that appear to have been created by hand These efforts benefit every field in which illustrations thanks to their ability to clarify emphasize and convey very precise meanings offer advantages over photographs These fields include medicine architecture entertainment education geography publishing and visualization Non Photorealistic Computer Graphics is the first and only resource to examine non photorealistic efforts in depth providing detailed accounts of the major algorithms as well as the background information and implementation advice readers need to make headway with these increasingly important techniques Already an estimated 10% of computer graphics users require some form of non photorealism Strothotte and Schlechtweg s important new book is designed and destined to be the standard NPR reference for this large diverse and growing group of professionals Hard to find information needed by a wide range and growing number of computer graphics programmers and applications users Traces NPR principles and techniques back to their origins in human vision and perception Focuses on areas that stand to benefit most from advances in NPR including medical and architectural illustration cartography and data visualization Presents algorithms for two and three dimensional effects using pseudo code where needed to clarify complex steps Helps readers attain pen and ink pencil sketch and painterly effects in addition to other styles Explores specific challenges for NPR including wrong marks deformation natural media artistic technique lighting and dimensionality Includes a series of programming projects in which readers can apply the book s concepts and algorithms

Non-Photorealistic Computer Graphics Thomas Strothotte, Stefan Schlechtweg, 2002-04-27 Even as developments in photorealistic computer graphics continue to affect our work and leisure activities practitioners and researchers are devoting more and more attention to non photorealistic NPR techniques for generating images that appear to have been created by hand These efforts benefit every field in which illustrations thanks to their ability to clarify emphasize and convey very precise meanings offer advantages over photographs These fields include medicine architecture entertainment education geography publishing and visualization Non Photorealistic Computer Graphics is the first and only resource to examine non photorealistic efforts in depth providing detailed accounts of the major algorithms as well as the background information and implementation advice readers need to make headway with these increasingly important techniques Already an estimated 10% of computer graphics users require some form of non photorealism Strothotte and Schlechtweg s important new book is designed and destined to be the standard NPR reference for this large diverse and growing group of professionals Hard to find information needed by a wide range and growing number of computer graphics programmers and applications users Traces NPR principles and techniques back to their origins in human vision and perception Focuses on areas that stand to benefit most from advances in NPR

including medical and architectural illustration cartography and data visualization Presents algorithms for two and three dimensional effects using pseudo code where needed to clarify complex steps Helps readers attain pen and ink pencil sketch and painterly effects in addition to other styles Explores specific challenges for NPR including wrong marks deformation natural media artistic technique lighting and dimensionality Includes a series of programming projects in which readers can apply the book s concepts and algorithms Non-Photorealistic Computer Graphics Thomas Strothotte,Stefan

Schlechtweg,2002-04-12 Penning one of the first books to offer a systematic assessment of computer graphics the authors provide detailed accounts of today s major non photorealistic algorithms along with the background information and implementation advice users need to put them to productive use *Non-Photorealistic Rendering* Bruce Gooch,Amy

Gooch,2001-07-18 The ubiquity of computer generated imagery around us in movies advertising or on the Internet is already being taken for granted and what impresses most people is the photorealistic quality of the images Pictures as we have often been told are worth a thousand words and the information transported by an image can take many different forms Man

The Algorithms and Principles of Non-photorealistic Graphics Weidong Geng,2011-02-02 The Algorithms and Principles of Non photorealistic Graphics Artistic Rendering and Cartoon Animation provides a conceptual framework for and comprehensive and up to date coverage of research on non photorealistic computer graphics including methodologies algorithms and software tools dedicated to generating artistic and meaningful images and animations This book mainly discusses how to create art from a blank canvas how to convert the source images into pictures with the desired visual effects how to generate artistic renditions from 3D models how to synthesize expressive pictures from textual graphical and pictorial data and how to speed up the production of cartoon animation sequences with temporal coherence It is intended for researchers and graduate students in the fields of computer graphics digital media arts and cartoon animation Dr Weidong Geng is a professor at the Department of Digital Media Technology and State Key Laboratory of Computer Aided Design and Computer Graphics Zhejiang University China *Non-Photorealistic Computer Graphics* Thomas Strothotte,Stefan

Schlechtweg,2002-04-24 Even as developments in photorealistic computer graphics continue to affect our work and leisure activities practitioners and researchers are devoting more and more attention to non photorealistic NPR techniques for generating images that appear to have been created by hand These efforts benefit every field in which illustrations thanks to their ability to clarify emphasize and convey very precise meanings offer advantages over photographs These fields include medicine architecture entertainment education geography publishing and visualization Non Photorealistic Computer Graphics is the first and only resource to examine non photorealistic efforts in depth providing detailed accounts of the major algorithms as well as the background information and implementation advice readers need to make headway with these increasingly important techniques Already an estimated 10% of computer graphics users require some form of non photorealism Strothotte and Schlechtweg s important new book is designed and destined to be the standard NPR reference

for this large diverse and growing group of professionals Hard to find information needed by a wide range and growing number of computer graphics programmers and applications users Traces NPR principles and techniques back to their origins in human vision and perception Focuses on areas that stand to benefit most from advances in NPR including medical and architectural illustration cartography and data visualization Presents algorithms for two and three dimensional effects using pseudo code where needed to clarify complex steps Helps readers attain pen and ink pencil sketch and painterly effects in addition to other styles Explores specific challenges for NPR including wrong marks deformation natural media artistic technique lighting and dimensionality Includes a series of programming projects in which readers can apply the book s concepts and algorithms *Reproduction and Application of Stylistic Means in Non-photorealistic Computer Graphics* Thomas Luft,2010 *Non-photorealistic Rendering* Jerry M. Gardiner,2005 *Multimedia Cartography* William Cartwright,Michael P Peterson,Georg Gartner,2007-02-13 Multimedia Cartography provides a contemporary overview of the issues related to multimedia cartography and the design and production elements that are unique to this area of mapping The book has been written for professional cartographers interested in moving into multimedia mapping for cartographers already involved in producing multimedia titles who wish to discover the approaches that other practitioners in multimedia cartography have taken and for students and academics in the mapping sciences and related geographical fields wishing to update their knowledge about current issues related to cartographic design and production It provides a new approach to cartography one based on the exploitation of the many rich media components and avant garde approach that multimedia offers *Remote Sensing and Cognition* Raechel A. White,Arzu Coltekin,Robert R. Hoffman,2018-04-19 Human factors play a critical role in the design and interpretation of remotely sensed imagery for all Earth sciences Remote Sensing and Cognition Human Factors in Image Interpretation brings together current topics widely recognized and addressed regarding human cognition in geographic imagery especially remote sensing imagery with complex data It addresses themes around expertise including methods for knowledge elicitation and modeling of expertise the effects of different aspects of realism on the interpretation of the environment spatial learning using imagery the effect of visual perspective on interpretation and a variety of technologies and methods for utilizing knowledge in the analysis of remote sensing imagery Written by leaders in the field this book provides answers to the host of questions raised at the nexus of psychology and remote sensing Academics and researchers with an interest in the human issues surrounding the use of remote sensing data will find this book to be an invaluable resource The topics covered in this book are useful for both the scientific analysis of remote sensing imagery as well as the design and display of remote sensing imagery to facilitate a variety of other tasks including education and wayfinding Features Brings together remote sensing environmental and computer scientists discussing their work from a psychological or human factors perspective Answers questions related to aesthetics of scientific visualization and mathematical analysis of perceptible objects Explains the perception and interpretation of realistic representations Provides

illustrative real world examples Shows how the features of display symbols elements and patterns have clear effects on processes of perception and visual search

The Comic Artist's Tools Suite Joanna J. Gerr, 2022 As advancements are made in Computer Generated Imagery CGI software and Non Photorealistic Rendering NPR techniques modern comic artists have reaped the benefits of technology aided workflows by creating 3D CGI environments for their comic backgrounds However while several NPR techniques exist there remains a high barrier to entry for many non technical artists when learning how to use these techniques to their full ability This paper introduces the Comic Artist s Tools Suite CATS a system for the open source 3D modeling software Blender which enables artists to procedurally generate and synthesize a selection of curated Non Photorealistic Rendering NPR effects through an accessible and user friendly interface Users can quickly create and adjust shaders that customize the style of their 3D environment backgrounds bypassing the need to craft shaders by hand and speeding up the traditional workflow for rendering pipelines

Virtual Photography Ali Shobeiri, Helen Westgeest, 2024-09-03 While it has traditionally been seen as a means of documenting an external reality or expressing an internal feeling photography is now capable of actualizing never existed pasts and never lived experiences Thanks to the latest photographic technologies we can now take photos in computer games interpolate them in extended reality platforms or synthesize them via artificial intelligence To account for the most recent shifts in conceptualizations of photography this book proposes the term virtual photography as a binding theoretical framework defined as a photography that retains the efficiency and function of real photography made with or without a camera while manifesting these in an unfamiliar or noncustomary form

Dynamic and Mobile GIS Roland Billen, Elsa Joao, David Forrest, 2006-11-10 With the widespread use of PDAs wireless internet Internet based GIS and 3G and 4G telecommunications the technology supporting mobile GIS is rapidly gaining popularity and effectiveness Dynamic and Mobile GIS Investigating Changes in Space and Time addresses Web GIS mobile GIS and the modeling processing and representation of dynamic eve

[Advances in Visual Computing](#) Richard Boyle, Bahram Parvin, Darko Koracin, Ronald Chung, Hammoud, Muhammad Hussain, Kar-Han Tan, Roger Crawfis, Daniel Thalmann, David Kao, Lisa Avila, 2010-11-19 It is with great pleasure that we present the proceedings of the 6th International Symposium on Visual Computing ISVC 2010 which was held in Las Vegas Nevada ISVC provides a common umbrella for the four main areas of visual computing including vision graphics visualization and virtual reality The goal is to provide a forum for researchers scientists engineers and practitioners throughout the world to present their latest research findings ideas developments and applications in the broader area of visual computing This year the program consisted of 14 oral sessions one poster session 7 special tracks and 6 keynote presentations The response to the call for papers was very good we received over 300 submissions for the main symposium from which we accepted 93 papers for oral presentation and 73 papers for poster presentation Special track papers were solicited separately through the Organizing and Program Committees of each track A total of 44 papers were accepted for oral presentation and 6 papers for poster presentation in the

special tracks *Advances in Visual Computing* George Bebis, Richard Boyle, Bahram Parvin, Darko Koracin, Ronald Chung, Hammoud, Muhammad Hussain, Kar-Han Tan, Roger Crawfis, Daniel Thalmann, David Kao, Lisa Avila, 2010-11-05 The three volume set LNCS 6453 LNCS 6454 and LNCS 6455 constitutes the refereed proceedings of the 6th International Symposium on Visual Computing ISVC 2010 held in Las Vegas NV USA in November December 2010 The 93 revised full papers and 73 poster papers presented together with 44 full and 6 poster papers of 7 special tracks were carefully reviewed and selected from more than 300 submissions The papers of part I LNCS 6453 are organized in computational bioimaging computer graphics behavior detection and modeling low level color image processing feature extraction and matching visualization motion and tracking unconstrained biometrics advances and trends 3D mapping modeling and surface reconstruction and virtual reality Part II LNCS 6454 comprises topics such as calibration pose estimation and reconstruction segmentation stereo registration medical imaging low cost virtual reality expanding horizons best practices in teaching visual computing applications and video analysis and event recognition Part III LNCS 6455 mainly contains papers of the poster session and concludes with contributions addressing visualization as well as motion and tracking Computational Intelligence in Music, Sound, Art and Design Antonios Liapis, Juan Jesús Romero Cardalda, Anikó Ekárt, 2018-03-24 This book constitutes the refereed proceedings of the 7th International Conference on Evolutionary Computation in Combinatorial Optimization EvoMUSART 2018 held in Parma Italy in April 2018 co located with the Evo 2017 events EuroGP EvoCOP and EvoApplications The 21 revised full papers presented were carefully reviewed and selected from 33 submissions The papers cover a wide range of topics and application areas including generative approaches to music and visual art medical art therapy visualization in virtual reality jewellery design interactive evolutionary computation and the art theory of evolutionary computation Advances in Multimedia Information Processing - PCM 2004 Kiyoharu Aizawa, Yuichi Nakamura, Shin'ichi Satoh, 2004-11-22 Welcome to the proceedings of the 5th Pacific Rim Conference on Multimedia PCM 2004 held in Tokyo Waterfront City Japan November 30 December 3 2004 Following the success of the preceding conferences PCM 2000 in Sydney PCM 2001 in Beijing PCM 2002 in Hsinchu and PCM 2003 in Singapore the fifth PCM brought together the researchers developers practitioners and educators in the field of multimedia Theoretical breakthroughs and practical systems were presented at this conference thanks to the support of the IEEE Circuits and Systems Society IEEE Region 10 and IEEE Japan Council ACM SIGMM IEICE and ITE PCM2004 featured a comprehensive program including keynote talks regular paper presentations posters demos and special sessions We received 385 papers and the number of submissions was the largest among recent PCMs Among such a large number of submissions we accepted only 94 oral presentations and 176 poster presentations Seven special sessions were also organized by world leading researchers We kindly acknowledge the great support provided in the reviewing of submissions by the program committee members as well as the additional reviewers who generously gave their time The

many useful comments provided by the reviewing process must have been very valuable for the authors work This conference would never have happened without the help of many people We greatly appreciate the support of our strong organizing committee chairs and advisory chairs Among the chairs special thanks go to Dr Ichiro Ide and Dr Takeshi Naemura who smoothly handled publication of the proceedings with Springer Dr Kazuya Kodama did a fabulous job as our Web master

Artistic Style Characterization Tieta PUTRI, Automatic style characterization is the process of measuring extracting and analysing different formal elements Brushstroke technique in conjunction with other formal elements such as colour and texture play a vital role in defining an artistic style This thesis explores the stroke based style analysis of the paintings of Vincent van Gogh who is well known for his use of wide and repetitive brushstrokes Novel brushstroke extraction techniques are used to segment and analyse Van Gogh's brushstrokes The extracted features can then be compiled into a feature set which represents the quantified brushstrokes properties and tested using several classification based tests The most contributing factor for detecting visible brushstroke is the brushstroke's texture due to the fact that the texture based segmentation methods give more satisfactory results in extracting visible brushstrokes with their average classification accuracy and F measure being 98.30% and 0.973 respectively

A Computational Approach to Digital Chinese Painting and Calligraphy Songhua Xu, Francis C.M. Lau, Yunhe Pan, 2009-05-12 A Computational Approach to Digital Chinese Painting and Calligraphy is a technical book on computer science and its applications in the arts It focuses on Oriental digital arts in particular Chinese arts and painting offering a multi disciplinary treatment from the angles of computer graphics interactive techniques human computer interaction and artificial intelligence The book also discusses the unique difficulties and challenges of using the computer to produce Oriental arts including research results by the authors and their lessons and engineering experiences behind these efforts Songhua Xu is a computer scientist of Zhejiang University and Yale University as well as an honorary researcher of the University of Hong Kong Francis C M Lau is Professor at the University of Hong Kong where he leads the Systems Research Group in the Department of Computer Science Yunhe Pan is Professor of Computer Science at Zhejiang University as well as Deputy President of Chinese Academy of Engineering

Computational Photography Rastislav Lukac, 2017-12-19 Computational photography refers broadly to imaging techniques that enhance or extend the capabilities of digital photography This new and rapidly developing research field has evolved from computer vision image processing computer graphics and applied optics and numerous commercial products capitalizing on its principles have already appeared in diverse market applications due to the gradual migration of computational algorithms from computers to imaging devices and software Computational Photography Methods and Applications provides a strong fundamental understanding of theory and methods and a foundation upon which to build solutions for many of today's most interesting and challenging computational imaging problems Elucidating cutting edge advances and applications in digital imaging camera image processing and computational photography with a focus on related research challenges this book

Describes single capture image fusion technology for consumer digital cameras Discusses the steps in a camera image processing pipeline such as visual data compression color correction and enhancement denoising demosaicking super resolution reconstruction deblurring and high dynamic range imaging Covers shadow detection for surveillance applications camera driven document rectification bilateral filtering and its applications and painterly rendering of digital images Presents machine learning methods for automatic image colorization and digital face beautification Explores light field acquisition and processing space time light field rendering and dynamic view synthesis with an array of cameras Because of the urgent challenges associated with emerging digital camera applications image processing methods for computational photography are of paramount importance to research and development in the imaging community Presenting the work of leading experts and edited by a renowned authority in digital color imaging and camera image processing this book considers the rapid developments in this area and addresses very particular research and application problems It is ideal as a stand alone professional reference for design and implementation of digital image and video processing tasks and it can also be used to support graduate courses in computer vision digital imaging visual data processing and computer graphics among others

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